

8. a. No nonparticipants are people with name tags.
b. Some of the people with name tags are participants.
9. a. Some perennials are plants that grow from tubers.
b. Some plants that do not grow from tubers are perennials.
- ▲ 10. a. Some decks that play digital tape are not devices equipped for radical oversampling.
b. All devices that are equipped for radical oversampling are decks that will not play digital tape.

Exercise 8-9

Which of the following arguments is valid? (Remember, an argument is valid when the truth of its premises guarantees the truth of its conclusion.)

- ▲ 1. Whenever the battery is dead, the screen goes blank; that means, of course, that whenever the screen goes blank, the battery is dead.
2. For a while there, some students were desperate for good grades, which meant some weren't, right?
3. Some players in the last election weren't members of the Reform Party. Obviously, therefore, some members of the Reform Party weren't players in the last election.
- ▲ 4. Since some of the students who failed the exam were students who didn't attend the review session, it must be that some students who weren't at the session failed the exam.
5. None of the people who arrived late were people who got good seats, so none of the good seats were occupied by latecomers.
- ▲ 6. *A claim* Everybody who arrived on time was given a box lunch, so the people who did not get a box lunch were those who didn't get there on time.
- ▲ 7. None of the people who gave blood are people who were tested, so everybody who gave blood must have been untested.
8. Some of the people who were not tested are people who were allowed to give blood, from which it follows that some of the people who were *not* allowed to give blood must have been people who were tested.
9. Everybody who was in uniform was able to play, so nobody who was out of uniform must have been able to play.
- ▲ 10. Not everybody in uniform was allowed to play, so some people who were not allowed to play must not have been people in uniform.

Exercise 8-10

For each pair of claims, assume that the first has the truth value given in parentheses. Using the operations of conversion, obversion, and contraposition along with the square of opposition, decide whether the second claim is true, is false, or remains undetermined.

Example

- a. No aardvarks are nonmammals. (True)
- b. Some aardvarks are not mammals.

Claim (a) can be obverted to "All aardvarks are mammals." Because all categorical claims are equivalent to their obverses, the truth of this claim

follows from that of (a). Because this claim is the contradictory of claim (b), it follows that claim (b) must be false.

Note: If we had been unable to make the two claims correspond without performing an illegitimate operation (such as converting an A-claim), then the answer is automatically *undetermined*.

- ▲ 1. a. No mosquitoes are poisonous creatures. (True)
b. Some poisonous creatures are mosquitoes.
2. a. Some students are not ineligible candidates. (True)
b. No eligible candidates are students.
- ▲ 3. a. Some sound arguments are not invalid arguments. (True)
b. All valid arguments are unsound arguments.
4. a. Some residents are nonvoters. (False)
b. No voters are residents.
- ▲ 5. a. Some automobile plants are not productive factories. (True)
b. All unproductive factories are automobile plants.

Many of the following will have to be rewritten as standard-form categorical claims before they can be answered.

6. a. Most opera singers take voice lessons their whole lives. (True)
b. Some opera singers do not take voice lessons their whole lives.
7. a. The hero gets killed in some of Gary Brodnax's novels. (False)
b. The hero does not get killed in some of Gary Brodnax's novels.
8. a. None of the boxes in the last shipment are unopened. (True)
b. Some of the opened boxes are not boxes in the last shipment.
- ▲ 9. a. Not everybody who is enrolled in the class will get a grade. (True)
b. Some people who will not get a grade are enrolled in the class.
10. a. Persimmons are always astringent when they have not been left to ripen. (True)
b. Some persimmons that have been left to ripen are not astringent.

CATEGORICAL SYLLOGISMS

A **syllogism** is a two-premise deductive argument. A **categorical syllogism** (in standard form) is a syllogism whose every claim is a standard-form categorical claim and in which three terms each occur exactly twice in exactly two of the claims. Study the following example:

All Americans are consumers.
Some consumers are not Democrats.
Therefore, some Americans are not Democrats.

Notice how each of the three terms "Americans," "consumers," and "Democrats" occurs exactly twice in exactly two different claims. The terms of a syllogism are sometimes given the following labels:

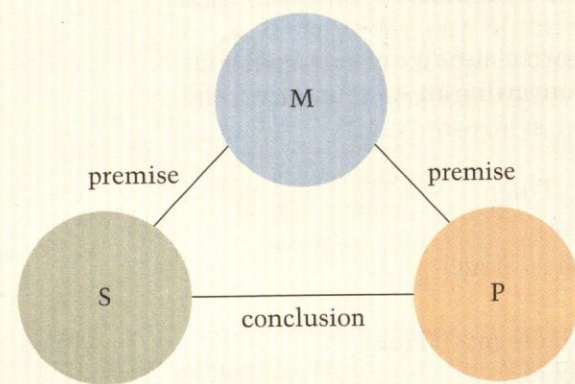


FIGURE 6 Relationship of terms in categorical syllogisms.

Major term: the term that occurs as the predicate term of the syllogism's conclusion

Minor term: the term that occurs as the subject term of the syllogism's conclusion

Middle term: the term that occurs in both of the premises but not at all in the conclusion

The most frequently used symbols for these three terms are *P* for major term, *S* for minor term, and *M* for middle term.

We use these symbols throughout to simplify the discussion.

In a categorical syllogism, each of the premises states a relationship between the middle term and one of the other terms, as shown in Figure 6. If both premises do their jobs correctly—that is, if the proper connections between *S* and *P* are established via the middle term, *M*—then the relationship between *S* and *P* stated by the conclusion will have to follow—that is, the argument is valid.

In case you're not clear about the concept of validity, remember: An argument is valid if, and only if, it is not possible for its premises to be true while its conclusion is false. This is just another way of saying that, were the

Real Life

Some Do; Therefore, Some Don't



Some mosquitoes carry West Nile virus. So it must be that there are some that don't.

The conclusion of this type of argument ("Some don't"), while it may be true, does not follow from the premise, because it could just as easily be false.

You sometimes hear arguments like this worked in reverse: "Some mosquitoes don't carry West Nile; therefore, some do." Equally invalid. The only way to get an I-claim from an O-claim is by obverting the O-claim.

premises of a valid argument true (whether or not they are in fact true), then the truth of the conclusion would be guaranteed. In a moment, we'll begin developing the first of two methods for assessing the validity of syllogisms.

First, though, let's look at some candidates for syllogisms. In fact, only one of the following qualifies as a categorical syllogism. Can you identify which one? What is wrong with the other two?

1. All cats are mammals.
Not all cats are domestic.
Therefore, not all mammals are domestic.
2. All valid arguments are good arguments.
Some valid arguments are boring arguments.
Therefore, some good arguments are boring arguments.
3. Some people on the committee are not students.
All people on the committee are local people.
Therefore, some local people are nonstudents.

We hope it was fairly obvious that the second argument is the only proper syllogism. The first example has a couple of things wrong with it: Neither the second premise nor the conclusion is in standard form—no standard-form categorical claim begins with the word "not"—and the predicate term must be a noun or noun phrase. The second premise can be translated into "Some cats are not domestic creatures" and the conclusion into "Some mammals are not domestic creatures," and the result is a syllogism. The third argument is okay up to the conclusion, which contains a term that does not occur anywhere in the premises: "nonstudents." However, because "nonstudents" is the complement of "students," this argument can be turned into a proper syllogism by obverting the conclusion, producing "Some local people are not students."

Once you're able to recognize syllogisms, it's time to learn how to determine their validity. We'll turn now to our first method, the Venn diagram test.

The Venn Diagram Method of Testing for Validity

Diagramming a syllogism requires three overlapping circles, one representing each class named by a term in the argument. To be systematic, in our diagrams we put the minor term on the left, the major term on the right, and the middle term in the middle but lowered a bit. We will diagram the following syllogism step by step:

No Republicans are collectivists.
All socialists are collectivists.
Therefore, no socialists are Republicans.

In this example, "socialists" is the minor term, "Republicans" is the major term, and "collectivists" is the middle term. See Figure 7 for the three circles required, labeled appropriately.

We fill in this diagram by diagramming the premises of the argument just as we diagrammed the A-, E-, I-,



"Syllogisms won't do you any good here, Mr. Aristotle."

and O-claims earlier. The premises in the foregoing example are diagrammed like this: First: No Republicans are collectivists (Figure 8). Notice that in this figure we have colored the entire area where the Republican and collectivist circles overlap.

Second: All socialists are collectivists (Figure 9). Because diagramming the premises resulted in the coloring of the entire area where the socialist and Republican circles overlap, and because that is exactly what we would do to diagram the syllogism's conclusion, we can conclude that the syllogism is valid. In general, a syllogism is valid if and only if diagramming the premises automatically produces a correct diagram of the conclusion.* (The one exception is discussed later.)

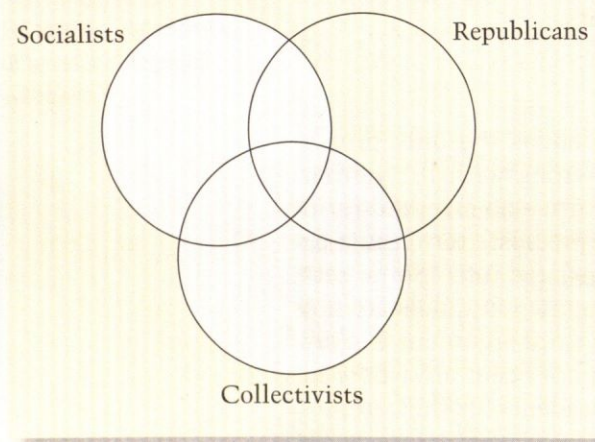


FIGURE 7 Before either premise has been diagrammed.

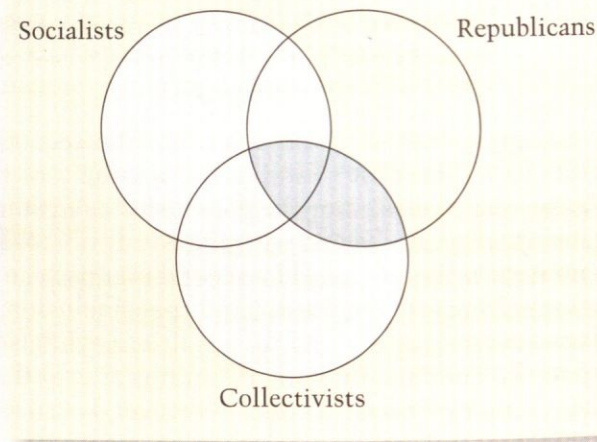


FIGURE 8 One premise diagrammed.

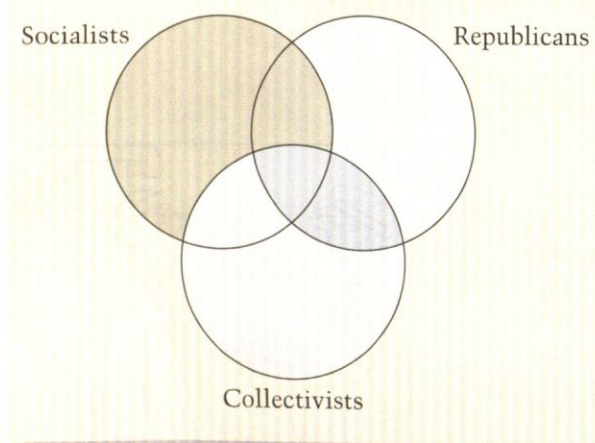


FIGURE 9 Both premises diagrammed.

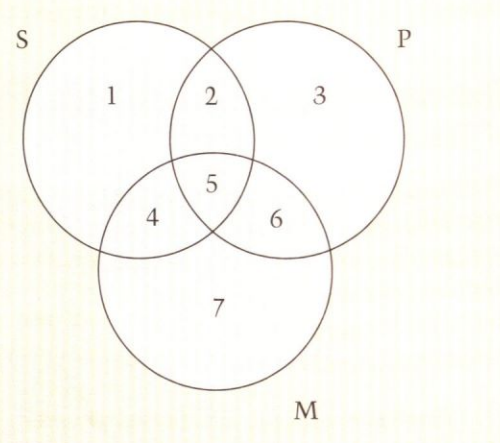


FIGURE 10

*It might be helpful for some students to produce two diagrams, one for the premises of the argument and one for the conclusion. The two can then be compared: Any area of the conclusion diagram that is colored must also be colored in the premises diagram, and any area of the conclusion diagram that has an X must also have one in the premises diagram. If both of these conditions are met, the argument is valid. (Thanks to Professor Ellery Eells of the University of Wisconsin, Madison, for the suggestion.)

When one of the premises of a syllogism is an I- or O-premise, there can be a problem about where to put the required X. The following example presents such a problem (see Figure 10 for the diagram). Note in the diagram that we have numbered the different areas in order to refer to them easily.

Some S are not M.
 All P are M.
 Some S are not P.

(The horizontal line separates the premises from the conclusion.)

An X in either area 1 or area 2 of Figure 10 makes the claim "Some S are not M" true, because an inhabitant of either area is an S but not an M. How do we determine which area should get the X? In some cases, the decision can be made for us: When one premise is an A- or E-premise and the other is an I- or O-premise, diagram the A- or E-premise first. (Always color areas in before putting in Xs.) Refer to Figure 11 to see what happens with the current example when we follow this rule.

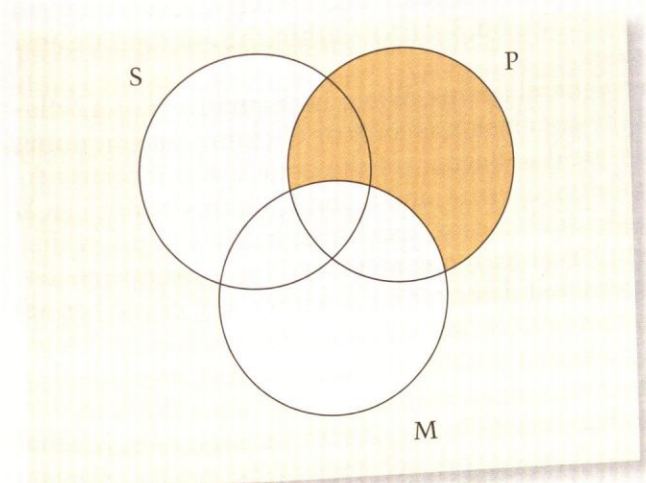


FIGURE 11

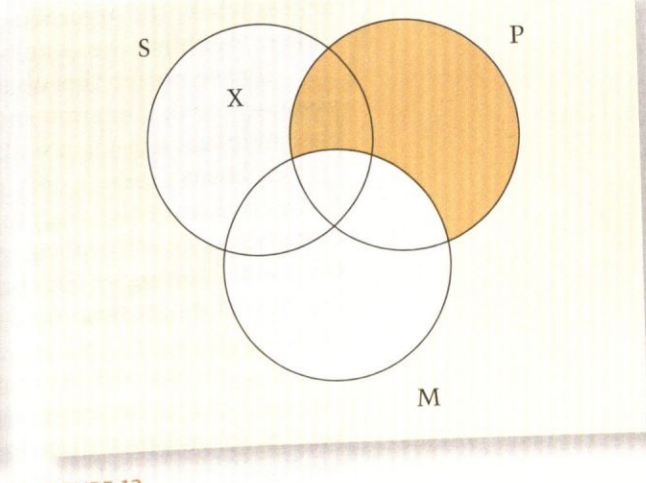


FIGURE 12

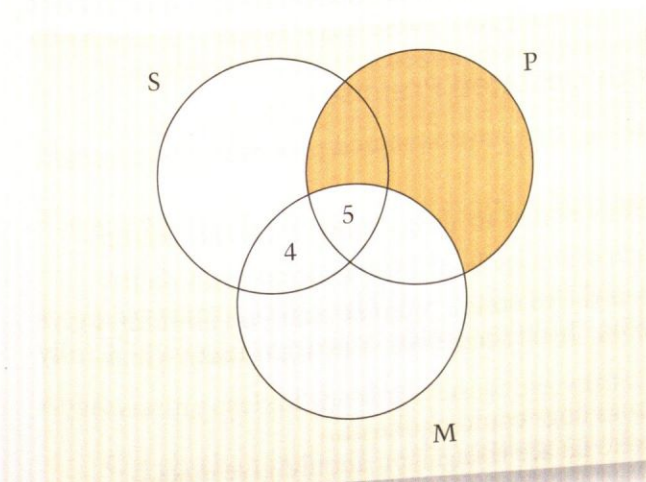


FIGURE 13

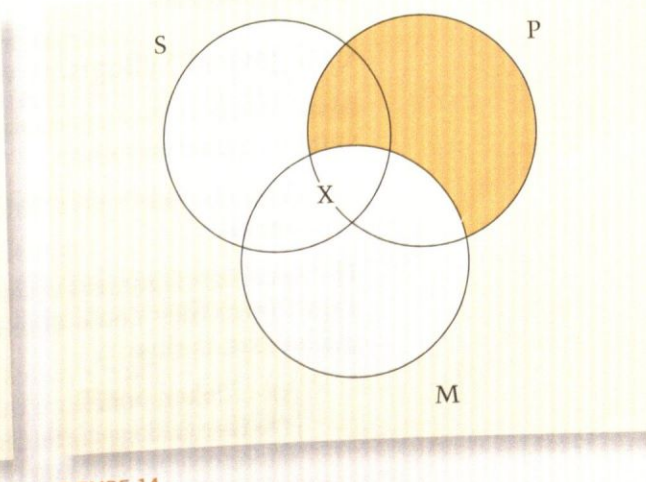


FIGURE 14

Once the A-claim has been diagrammed, there is no longer a choice about where to put the X—it has to go in area 1. Hence, the completed diagram for this argument looks like Figure 12. And from this diagram, we can read the conclusion “Some S are not P,” which tells us that the argument is valid.

In some syllogisms, the rule just explained does not help. For example,

All P are M.
Some S are M.
Some S are P.

A syllogism like this one still leaves us in doubt about where to put the X, even after we have diagrammed the A-premise (Figure 13): Should the X go in area 4 or 5? When such a question remains unresolved, here is the rule to follow: *An X that can go in either of two areas goes on the line separating the areas, as in Figure 14.*

In essence, an X on a line indicates that the X belongs in one or the other of the two areas, maybe both, but we don't know which. When the time comes to see whether the diagram yields the conclusion, we look to see whether there is an X *entirely* within the appropriate area. In the current example, we would need an X entirely within the area where S and P overlap; because there is no such X, the argument is invalid. An X *partly* within the appropriate area fails to establish the conclusion.

Please notice this about Venn diagrams: When both premises of a syllogism are A- or E-claims and the conclusion is an I- or O-claim, diagramming the premises cannot possibly yield a diagram of the conclusion (because A- and E-claims produce only coloring of areas, and I- and O-claims require an X to be read from the diagram). In such a case, remember our assumption that every class we are dealing with has at least one member. This assumption justifies our looking at the diagram and determining whether any circle has all but one of its areas colored. *If any circle has only one area remaining uncolored, an X should be put in that area.* This is the case because any member of that class has to be in that remaining area. Sometimes placing the X in this way will enable us to read the conclusion, in which case the argument is valid (on the assumption that the relevant class is not empty); sometimes placing the X will not enable us to read the conclusion, in which case the argument is invalid, with or without any assumptions about the existence of a member within the class.

Categorical Syllogisms with Unstated Premises

Many “real-life” categorical syllogisms have unstated premises. For example, suppose somebody says,

You shouldn't give chicken bones to dogs. They could choke on them.

The speaker's argument rests on the unstated premise that you shouldn't give dogs things they could choke on. In other words, the argument, when fully spelled out, is this:

All chicken bones are things dogs could choke on.
[No things dogs could choke on are things you should give dogs.]
Therefore, no chicken bones are things you should give dogs.

The unstated premise appears in brackets.

To take another example:

Driving around in an old car is dumb, since it might break down in a dangerous place.

Here, the speaker's argument rests on the unstated premise that it's dumb to risk a dangerous breakdown. In other words, when fully spelled out, the argument is this:

All examples of driving around in an old car are examples of risking dangerous breakdown.
[All examples of risking dangerous breakdown are examples of being dumb.]
Therefore, all examples of driving around in an old car are examples of being dumb.

When you hear (or give) an argument that looks like a categorical syllogism that has only one stated premise, usually a second premise has been assumed and not stated. Ordinarily, this unstated premise remains unstated because the speaker thinks it is too obvious to bother stating. The unstated premises in the arguments above are good examples: “You shouldn't give dogs things they could choke on,” and “It is dumb to risk a dangerous breakdown.”

When you encounter (or give) what looks like a categorical syllogism that is missing a premise, ask: Is there a reasonable assumption I could make that would make this argument valid? We covered this question of unstated premises in more detail in Chapter 2, and you might want to look there for more information on the subject.

At the end of this chapter, we have included a few exercises that involve missing premises.

Real-Life Syllogisms

We'll end this section with a word of advice. Before you use a Venn diagram (or the rules method described below) to determine the validity of real-life arguments, it helps to use a letter to abbreviate each category mentioned in the argument. This is mainly just a matter of convenience: It is easier to write down letters than to write down long phrases.

Take the first categorical syllogisms given on page 275:

You shouldn't give chicken bones to dogs because they could choke on them.

The argument spelled out, once again, is this:

All chicken bones are things dogs could choke on.
[No things dogs could choke on are things you should give dogs.]
Therefore, no chicken bones are things you should give dogs.

Abbreviating each of the three categories with a letter, we get

C = chicken bones; D = things dogs could choke on; and S = things you should give dogs.

Real Life

The World's Most Common Syllogism

We're pretty sure the syllogism you'll run across most frequently is of this form:

- All As are Bs.
- All Bs are Cs.
- All As are Cs.

Some real-life versions are easier to spot than others. Here's an example: "The chords in that song are all minor chords because every one of them has a flatted third, and that automatically makes them minor chords." Here's another: "Jim will be on a diet every day next week, so you can expect him to be grumpy the whole time. He's *always* grumpy when he's on a diet."

Real Life

The World's Second Most Common Syllogism

If a real, live syllogism turns out not to have the form described in the previous box, there's a very good chance it has this form:

- All As are Bs.
- No Bs are Cs.
- No As are Cs.

Here's an example: "Eggs and milk are obviously animal products, and since real vegans don't eat any kind of animal product at all, they surely don't eat eggs or milk."

Then, the argument is

- All C are D.
- [No D are S]
- Therefore, no C are S.

Likewise, the second argument was this:

Driving around in an old car is dumb, since it might break down in a dangerous place.

When fully spelled out, the argument is

- All examples of driving around in an old car are examples of risking dangerous breakdown.
- [All examples of risking dangerous breakdown are examples of being dumb.]
- Therefore, all examples of driving around in an old car are examples of being dumb.



We're not certain exactly what the AT&T people had in mind here, but it *looks* like a syllogism with the conclusion unstated. With the conclusion "Your world is AT&T," is the argument valid? What if the conclusion were "AT&T is your world"?

Abbreviating each of the three categories, we get

D = examples of driving around in an old car; R = examples of risking dangerous breakdown; S = examples of being dumb.

Then, the argument is

- All D are R.
- [All R are S]
- Therefore, all D are S.

A final tip: Take the time to write down your abbreviation key clearly.

Use the diagram method to determine which of the following syllogisms are valid and which are invalid. **Exercise 8-11**

- ▲ ~~A~~ 1. All paperbacks are books that use glue in their spines.
No books that use glue in their spines are books that are sewn in signatures.
No books that are sewn in signatures are paperbacks.
- 2. All sound arguments are valid arguments.
Some valid arguments are not interesting arguments.
Some sound arguments are not interesting arguments.
- 3. All topologists are mathematicians.
Some topologists are not statisticians.
Some mathematicians are not statisticians.
- ▲ 4. Every time Louis is tired, he's edgy. He's edgy today, so he must be tired today.

5. Every voter is a citizen, but some citizens are not residents. Therefore, some voters are not residents.
6. All the dominant seventh chords are in the mixolydian mode, and no mixolydian chords use the major scale. So no chords that use the major scale are dominant sevenths.
- ▲ 7. All halyards are lines that attach to sails. Painters do not attach to sails, so they must not be halyards.
8. Only systems with no moving parts can give you instant access. Standard hard drives have moving parts, so they can't give you instant access.
9. All citizens are residents. So, since no noncitizens are voters, all voters must be residents.
- ▲ 10. No citizens are nonresidents, and all voters are citizens. So, all residents must be nonvoters.

Exercise 8-12

Put the following arguments in standard form (you may have to use the obversion, conversion, or contraposition operations to accomplish this); then determine whether the arguments are valid by means of diagrams.

- ▲ 1. No blank disks contain any data, although some blank disks are formatted. Therefore, some formatted disks do not contain any data.
2. All ears of corn with white tassels are unripe, but some ears are ripe even though their kernels are not full-sized. Therefore, some ears with full-sized kernels are not ears with white tassels.
3. Prescription drugs should never be taken without a doctor's order. So no over-the-counter drugs are prescription drugs, because all over-the-counter drugs can be taken without a doctor's order.
- ▲ 4. All tobacco products are damaging to people's health, but some of them are addictive substances. Some addictive substances, therefore, are damaging to people's health.
5. A few CD players use 24× sampling, so some of them must cost at least twenty dollars, because you can't buy any machine with 24× sampling for less than twenty dollars.
6. Everything that Pete won at the carnival must be junk. I know that Pete won everything that Bob won, and all the stuff that Bob won is junk.
- ▲ 7. Only people who hold stock in the company may vote, so Mr. Hansen must not hold any stock in the company, because I know he was not allowed to vote.
8. No off-road vehicles are allowed in the unimproved portion of the park, but some off-road vehicles are not four-wheel-drive. So some four-wheel-drive vehicles are allowed in the unimproved part of the park.
9. Some of the people affected by the new drainage tax are residents of the county, and many residents of the county are already paying the sewer tax. So, it must be that some people paying the sewer tax are affected by the new drainage tax, too.
- ▲ 10. No argument with false premises is sound, but some of them are valid. So, some unsound arguments must be valid.

Real Life

Brodie!

"Otterhounds are friendly, are fond of other dogs, bark a lot, and like to chase cats."
"That describes Brodie exactly! He must be an otterhound."

Not so fast, dog lover. The argument seems to be

All otterhounds are friendly, fond of other dogs, and like to chase cats.

Brodie is friendly, fond of other dogs, and likes to chase cats.

Therefore, Brodie is an otterhound.

This argument has the form

All As are X.

All Bs are X.

Therefore, all Bs are As.

If you use techniques described in this chapter, you will see that arguments with this form are invalid. If you just stumbled on this box, or if your instructor referred you to it, common sense should tell you the same. It's like arguing, "All graduates of Harvard are warm-blooded, and Brodie is warm-blooded; therefore, Brodie is a graduate of Harvard."

In Depth

Additional Common Invalid Argument Forms

Other common invalid argument forms (see the box about Brodie) include these:

All As are X.

No As are Y.

Therefore, no Xs are Ys.

All Xs are Ys; therefore, all Ys are Xs.

Some Xs are not Ys. Therefore, some Ys are not Xs.

Some Xs are Ys. Therefore, some Xs are not Ys.

Some Xs are not Ys. Therefore, some Xs are Ys.

So you don't get lost in all the Xs and Ys, and to help you remember them, we recommend you make up examples of each of these forms and share them with a classmate.

The Rules Method of Testing for Validity

The diagram method of testing syllogisms for validity is intuitive, but there is a faster method that makes use of three simple rules. These rules are based on two ideas, the first of which has been mentioned already: affirmative and negative categorical claims. (Remember, the A- and I-claims are affirmative;

A-claim: All (S) are P.
 E-claim: No (S) are (P).
 I-claim: Some S are P.
 O-claim: Some S are not (P).

FIGURE 15 Distributed terms.

the E- and O-claims are negative.) The other idea is that of *distribution*. Terms that occur in categorical claims are either distributed or undistributed: Either the claim says something about every member of the class the term names, or it does not.* Three of the standard-form claims distribute one or more of their terms. In Figure 15, the circled letters stand for distributed terms, and the uncircled ones stand for undistributed terms. As the figure shows, the A-claim distributes its subject term, the O-claim distributes its predicate term, the E-claim distributes both, and the I-claim distributes neither.

We can now state the three *rules of the syllogism*. A syllogism is valid if, and only if, all of these conditions are met:

1. **The number of negative claims in the premises must be the same as the number of negative claims in the conclusion.** (Because the conclusion is always one claim, this implies that no valid syllogism has two negative premises.)
2. **At least one premise must distribute the middle term.**
3. **Any term that is distributed in the conclusion of the syllogism must be distributed in its premises.**

These rules are easy to remember, and with a bit of practice, you can use them to determine quickly whether a syllogism is valid.

Which of the rules is broken in this example?

All pianists are keyboard players.
 Some keyboard players are not percussionists.
 Some pianists are not percussionists.

The term "keyboard players" is the middle term, and it is undistributed in both premises. The first premise, an A-claim, does not distribute its predicate term; the second premise, an O-claim, does not distribute its subject term. So this syllogism breaks rule 2.

Another example:

No dogs up for adoption at the animal shelter are pedigreed dogs.
 Some pedigreed dogs are expensive dogs.
 Some dogs up for adoption at the animal shelter are expensive dogs.

This syllogism breaks rule 1 because it has a negative premise but no negative conclusion.

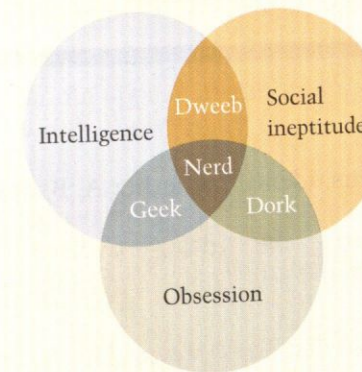
A last example:

No mercantilists are large landowners.
 All mercantilists are creditors.
 No creditors are large landowners.

*The above is a rough-and-ready definition of distribution. If you'd like a more technical version, here's one: A term is *distributed* in a claim if, and only if, on the assumption that the claim is true, the class named by the term can be replaced by *any* subset of that class without producing a false claim. Example: In the claim "All senators are politicians," the term "senators" is distributed because, assuming the claim is true, you can substitute *any* subset of senators (Democratic ones, Republican ones, tall ones, short ones) and the result must also be true. "Politicians" is not distributed: The original claim could be true while "All senators are honest politicians" was false.

Real Life

A Guide to Dweebs, Dorks, Geeks, and Nerds



We found this Venn diagram floating around on the web. It gives us a tongue-in-cheek (we think) sorting of various categories of people based on three characteristics: intelligence, social ineptitude, and obsession. You can interpret this in the same way we interpreted such diagrams in this chapter (e.g., a dweeb is a member of the class of intelligent people and of the class of the socially inept, but not a member of the class of the obsessed).

The minor term, "creditors," is distributed in the conclusion (because it's the subject term of an E-claim) but not in the premises (where it's the predicate term of an A-claim). So this syllogism breaks rule 3.

The following list of topics covers the basics of categorical logic as discussed in this chapter: **Recap**

- The four types of categorical claims include A, E, I, and O.
- There are Venn diagrams for the four types of claims.
- Ordinary English claims can be translated into standard-form categorical claims. Some rules of thumb for such translations are as follows:
 - "only" introduces predicate term of A-claim
 - "the only" introduces subject term of A-claim
 - "whenever" means times or occasions
 - "wherever" means places or locations
 - claims about individuals are treated as A- or E-claims
- The square of opposition displays contradiction, contrariety, and subcontrariety among corresponding standard-form claims.

- Conversion, obversion, and contraposition are three operations that can be performed on standard-form claims; some are equivalent to the original, and some are not.
- Categorical syllogisms are standardized deductive arguments; we can test them for validity by the Venn diagram method or by the rules method—the latter relies on the notions of distribution and the affirmative and negative qualities of the claims involved.

Additional Exercises

Exercise 8-13

In each of the following items, identify whether A, B, or C is the middle term.

- ▲ 1. All A are B.
All A are C.
All B are C.
- 2. All B are C.
No C are D.
No B are D.
- 3. Some C are not D.
All C are A.
Some D are not A.
- ▲ 4. Some A are not B.
Some B are C.
Some C are not A.
- 5. No C are A.
Some B are A.
Some C are not B.

Exercise 8-14

Which terms are distributed in each of the following?

- ▲ 1. All A are B.
 - a. A only
 - b. B only
 - c. Both A and B
 - d. Neither A nor B
- 2. No A are B.
 - a. A only
 - b. B only
 - c. Both A and B
 - d. Neither A nor B
- 3. Some A are B.
 - a. A only
 - b. B only
 - c. Both A and B
 - d. Neither A nor B

- ▲ 4. Some A are not B.
 - a. A only
 - b. B only
 - c. Both A and B
 - d. Neither A nor B

Exercise 8-15

How many negative claims appear in the premises of each of the following arguments? (In other words, how many of the premises are negative?) Your options are 0, 1, or 2.

- ▲ 1. All A are B.
All A are C.
Therefore, all B are C. *None*
- 2. All B are C.
No C are D.
Therefore, no B are D. *one*
- 3. Some C are not D.
All C are A.
Therefore, some D are not A. *one*
- ▲ 4. Some A are not B.
Some B are C.
Therefore, some C are not A. *one*
- 5. No A are B.
Some B are not C.
Some A are C. *two*

Exercise 8-16

Which rules (if any) are broken in each of the following? Select from these options:

- a. Breaks rule 1 only
 - b. Breaks rule 2 only
 - c. Breaks rule 3 only
 - d. Breaks more than one rule
 - e. Breaks no rule
- ▲ 1. All A are B.
All A are C.
Therefore, all B are C. *R1 ✓ R2 ✓ R3 X*
 - 2. All B are C.
No C are D.
Therefore, no B are D.
 - 3. Some C are not D.
All C are A.
Therefore, some D are A.

- C ▲ 4. Some A are not B.
Some B are C.
Therefore, some C are not A.
- B 5. Some A are C.
Some C are B.
Therefore, some A are B.
- C 6. Some carbostats are framistans.
No framistans are arbuckles.
Some arbuckles are not carbostats.
- B ▲ 7. All framistans are veeblefetzers.
Some veeblefetzers are carbostats.
Some framistans are carbostats.
- C 8. No arbuckles are framistans.
All arbuckles are carbostats.
No framistans are carbostats. *OK*
- B 9. All members of the class are registered students.
Some registered students are not people taking fifteen units.
Some members of the class are not people taking fifteen units.
- B ▲ 10. All qualified mechanics are people familiar with hydraulics.
No unschooled people are people familiar with hydraulics.
No qualified mechanics are unschooled people.

Exercise 8-17

Which rules (if any) are broken in each of the following?

Note: If an argument breaks a rule, *which* rule is broken depends on how you translate the claims in the argument. For example, the claim "Dogs shouldn't be given chicken bones" could be translated as an *E-claim*: "No dogs are animals that should be given chicken bones." But it also could be translated as an *A-claim*: "All dogs are animals that shouldn't be given chicken bones." If the original claim appeared in an invalid argument, one rule would be broken if you translated it as the *E-claim*. A different rule would be broken if you translated it as the *A-claim*.

- ▲ 1. All tigers are ferocious creatures. Some ferocious creatures are zoo animals. Therefore, some zoo animals are tigers. (For this and the following items, it will help if you abbreviate each category with a letter. For example, let T = tigers, F = ferocious creatures, and Z = zoo animals.)
2. Some pedestrians are not jaywalkers. Therefore, some jaywalkers are not gardeners, since no gardeners are pedestrians.
3. Because all shrubs are ornamental plants, it follows that no ornamental plants are cacti, since no cacti qualify as shrubs.
- ▲ 4. Weightlifters aren't really athletes. Athletics requires the use of motor skills; and few, if any, weightlifters use motor skills.
5. The trick to finding syllogisms is to think categorically, as well as to focus on the key argument in a passage. For example, some passages contain a good bit of rhetoric, and some passages that do this make it hard to spot syllogisms, with the result that it is hard to spot syllogisms in some passages.

6. Every broadcast network has seen its share of the television audience decline during the past six years. But not every broadcast network that has a decline in television audience share has lost money. So, not every broadcast network has lost money.
- ▲ 7. Many students lift papers off the Internet, and this fact is discouraging to teachers. However, it must be noted that students who do this are only cheating themselves, and anyone who cheats himself or herself loses in the long run. Therefore, lifting papers off the Internet is a losing proposition in the long run.
8. When he was Speaker of the House, Mr. Newt Gingrich could be counted on to advance Republican causes. At the time, nobody who would do that could be accused of being soft on crime, which explains why, at the time, Gingrich could hardly be accused of being soft on crime.
9. It would be in everyone's interest to amend the Constitution to permit school prayer. And it is obviously in everyone's interest to promote religious freedom. It should be no surprise, then, that amending the Constitution to permit school prayer will promote religious freedom.
- ▲ 10. If you want to stay out all night dancing, it is fine with me. Just don't cry about it if you don't get good grades. Dancing isn't a total waste of time, but dancing the whole night certainly is. There are only so many hours in a day, and wasting time is bound to affect your grades negatively. So, fine, stay out dancing all night. It's your choice. But you have to expect your grades to suffer.

Exercise 8-18

- ▲ Refer back to Exercises 8-11 and 8-12 (pages 279–280), and check the arguments for validity using the rules. We recommend abbreviating each category with a letter.

Once again, remember: If an argument breaks a rule, *which* rule is broken depends on how you translate the claims in the argument. For example, the claim "Dogs shouldn't be given chicken bones" could be translated as an *E-claim*: "No dogs are animals that should be given chicken bones." But it also could be translated as an *A-claim* (the obverse of the other version): "All dogs are animals that shouldn't be given chicken bones." If the original claim appeared in an invalid argument, one rule would be broken if you translated it as an *E-claim*. A different rule would be broken if you translated it as an *A-claim*.

Answers to 2, 5, 7, and 8 of both exercises are given in the answer section.

Exercise 8-19

For each of the following items: Abbreviate each category with a letter, then translate the argument into standard form using the abbreviations. Then test the argument for validity using either the diagram method or the rules method.

Note: For many of these items, it can be difficult to translate the arguments into standard form.

- ▲ 1. Some athletes are not baseball players, and some baseball players are not basketball players. Therefore, some athletes are not basketball players.

2. Rats are disease-carrying pests and, as such, should be eradicated, because such pests should all be eradicated.
3. All creationists are religious, and all fundamentalists are religious, so all creationists are fundamentalists.
4. Every sportscaster is an athlete, and no athlete is a college professor. Therefore, no sportscasters are college professors.
5. Anyone who voted for the Democrats favors expansion of medical services for the needy. So, the people who voted for the Democrats all favor higher taxes, since anyone who wants to expand medical services must favor higher taxes.
6. All cave dwellers lived before the invention of the radio, and no one alive today is a cave dweller. Thus, no person who lived before the invention of the radio is alive today.
7. Conservationists don't vote for Republicans, and all environmentalists are conservationists. Thus, environmentalists don't vote for Republicans.
8. Since all philosophers are skeptics, it follows that no theologian is a skeptic, since no philosophers are theologians.
9. Each philosopher is a skeptic, and no philosopher is a theologian. Therefore, no skeptic is a theologian.
10. Peddlers are salesmen, and confidence men are, too. So, peddlers are confidence men.
11. Should drug addicts be treated as criminals? Well, addicts are all excluded from the class of decent people, yet all criminals belong to that class. Accordingly, no addicts are criminals.
12. Critical thinkers recognize invalid syllogisms; therefore, critical thinkers are logicians, since logicians can spot invalid syllogisms, too.
13. The Mohawk Indians are Algonquin, and so are the Cheyenne. So, the Mohawks are really just Cheyenne.
14. Idiots would support the measure, but no one else would. Whatever else you may think of the school board, you can't say they are idiots. [Therefore . . .]
- ▲ 15. This is not the best of all possible worlds, because the best of all possible worlds would not contain mosquitoes, and *this* world contains plenty of mosquitoes!
16. From time to time, the police have to break up parties here on campus, since some campus parties get out of control, and when a party gets out of control, well, you know what the police have to do.
17. I know that all fundamentalist Christians are evangelicals, and I'm pretty sure that all revivalists are also evangelicals. So, if I'm right, at least some fundamentalist Christians must be revivalists.
- ▲ 18. "Their new lawn furniture certainly looks cheap to me," she said. "It's made of plastic, and plastic furniture just looks cheap."
19. None of our intramural sports are sports played in the Olympics, and some of the intercollegiate sports are not Olympic sports, either. So, some of the intercollegiate sports are also intramural sports.
20. The moas were all Dinornithidae, and no moas exist anymore. So, there aren't any more Dinornithidae.

- ▲ 21. Everybody on the district tax roll is a citizen, and all eligible voters are also citizens. So, everybody on the district tax roll is an eligible voter.
22. Any piece of software that is in the public domain may be copied without permission or fee. But that cannot be done in the case of software under copyright. So, software under copyright must not be in the public domain.
23. None of the countries that have been living under dictatorships for these past few decades are familiar with the social requirements of a strong democracy—things like widespread education and a willingness to abide by majority vote. Consequently, none of these countries will make a successful quick transition to democracy, since countries where the aforementioned requirements are unfamiliar simply can't make such a transition.
- ▲ 24. Trust Senator Cobweb to vote with the governor on the new tax legislation. Cobweb is a liberal, and liberals just cannot pass up an opportunity to raise taxes.
25. Investor-held utilities should not be allowed to raise rates, since all public utilities should be allowed to raise rates, and public utilities are not investor held.
26. Masterpieces are no longer recorded on cassettes. This is because masterpieces belong to the classical repertoire, and classical music is no longer recorded on cassettes.
27. It isn't important to learn chemistry, since it isn't very useful, and there isn't much point in learning something that isn't useful.
28. Stockholders' information about a company's worth must come from the managers of that company, but in a buy-out, the managers of the company are the very ones who are trying to buy the stock from the stockholders. So, ironically, in a buyout situation, stockholders must get their information about how much a company is worth from the very people who are trying to buy their stock.
- ▲ 29. All the networks devoted considerable attention to reporting poll results during the last election, but many of those poll results were not especially newsworthy. So, the networks have to admit that some unnewsworthy items received quite a bit of their attention.
- ▲ 30. If a person doesn't understand that the earth goes around the sun once a year, then that person can't understand what causes winter and summer. Strange as it may seem, then, there are many American adults who don't know what causes winter and summer, because a survey a year or so ago showed that many such adults don't know that the earth goes around the sun.
31. Congress seems ready to impose trade sanctions on China, and perhaps it should. China's leaders cruelly cling to power. They flout American interests in their actions in Tibet, in their human-rights violations, in their weapons sales, and in their questionable trade practices. Any country with a record like this deserves sanctions.
- ▲ 32. Since 1973, when the U.S. Supreme Court decided *Miller v. California*, no work can be banned as obscene unless it contains sexual depictions that are "patently offensive" to "contemporary community standards"

and unless the work as a whole possesses no "serious literary, artistic, political or scientific value." As loose as this standard may seem when compared with earlier tests of obscenity, the pornographic novels of "Madame Toulouse" (a pseudonym, of course) can still be banned. They would offend the contemporary standards of *any* community, and to claim any literary, artistic, political, or scientific value for them would be a real joke.

Exercise 8-20

This exercise is a little different, and you may need to work one or more such items in class in order to get the hang of them. Your job is to try to prove each of the following claims about syllogisms true or false. You may need to produce a general argument—that is, show that *every* syllogism that does *this* must also do *that*—or you may need to produce a counterexample, that is, an example that proves the claim in question false. The definition of categorical syllogism and the rules of the syllogism are of crucial importance in working these examples.

- ▲ 1. Every valid syllogism must have at least one A- or E-claim for a premise.
- 2. Every valid syllogism with an E-claim for a premise must have an E-claim for a conclusion.
- 3. Every valid syllogism with an E-claim for a conclusion must have an E-claim for a premise.
- ▲ 4. It's possible for a syllogism to break two of the rules of the syllogism.
- 5. No syllogism can break all three of the rules of the syllogism.

Exercise 8-21

For each of these, identify a premise (or conclusion) that makes the item a valid, standard-form categorical syllogism. If this cannot be done, say so.

- ▲ 1. All A are B.
???
Therefore, all A are C.
- 2. All B are C.
???
Therefore, no B are D.
- 3. Some C are D.
???
Therefore, some D are not A.
- ▲ 4. All A are B.
Some B are not C.
Therefore, ???
- 5. Some A are B.
Some B are C.
Therefore, ???
- 6. Some A are not C.
Some A are not D.
Therefore, ???

- ▲ 7. All A are B.
No A are C.
Therefore, ????
- 8. No A are B.
???
Therefore, some B are not C.
- 9. No B are A.
???
Therefore, no B are C.
- 10. Some A are B.
Some B are not C.
Therefore, ???

Exercise 8-22

Follow the instructions for each item.

- ▲ 1. "All business executives have accounting experience, and some business executives are not economists."
Which of the following statements follows validly from these premises?
 - a. Some economists do not have accounting experience.
 - b. Some people with accounting experience are not economists.
 - ✗ c. All people with accounting experience are business executives.
 - d. More than one of these.
 - e. None of these.
- 2. "Coffee is a stimulant, since coffee contains caffeine."
What statement must be added to this syllogism to make it valid?
 - a. All substances that contain caffeine are stimulants.
 - b. All stimulants are substances that contain caffeine.
 - c. Neither of the above makes it valid.
 - d. Both of the above make it valid.
- 3. "All musicians can read music; plus, all Washington University music majors can read music."
Which of the following statements follows validly from these premises?
 - a. Anyone who can read music is a musician.
 - b. All Washington University music majors are musicians.
 - c. Neither of the above.
 - d. Both of the above.
- ▲ 4. "All CEOs are college grads. Therefore, some college grads are not economists."
What statement must be added to this syllogism to make it valid?
 - a. Some CEOs are not economists.
 - b. Some economists are not CEOs.
 - c. Neither of the above makes it valid.
 - d. Both of the above make it valid.

5. "Some economists are historians; therefore, some radicals are not historians."
What statement must be added to this syllogism to make it valid?
- No economists are radicals.
 - Some economists are not radicals.
 - Some radicals are not economists.
 - None of the above make it valid.
6. "All online businesses are modern businesses, from which an obvious conclusion follows, since modern businesses don't include any brick-and-mortar businesses." What conclusion, if any, makes this a valid categorical syllogism?
- ▲ 7. "Political radicals never become Navy SEALs, from which it follows that some patriots are not Navy Seals." What premise must be added to make this a valid categorical syllogism?
8. "A few NASCAR drivers are NASCAR fans, but no Minnesotans are NASCAR fans." What conclusion, if any, makes this a valid categorical syllogism?
9. "All physicians own mutual funds, from which it follows that no professors are physicians." What premise must be added to make this a valid categorical syllogism?
- ▲ 10. "Some private investigators carry sidearms, and some people who carry sidearms are not licensed to do so." What conclusion, if any, makes this a valid categorical syllogism?

Exercise 8-23

The following is an anonymous statement of opinion that appeared in a newspaper call-in column.

This is in response to the person who called in that we should provide a shelter for the homeless, because I think that is wrong. These people make the downtown area unsafe because they have nothing to lose by robbing, mugging, etc. The young boy killed by the horseshoe pits was attacked by some of these bums, assuming that witnesses really saw people who were homeless, which no doubt they did, since the so-called homeless all wear that old worn-out hippie gear, just like the people they saw. They also lower property values. And don't tell me they are down and out because they can't find work. The work is there if they look for it. They choose for themselves how to live, since if they didn't choose, who did?

A lot of things might be said in criticism of this tirade, but what we want you to notice is the breakdown of logic. The piece contains, in fact, a gross logic error, which we ask you to make the focus of a critical essay. Your audience is the other members of your class; that is, you are writing for an audience of critical thinkers.

Exercise 8-24

Pornography violates women's rights. It carries a demeaning message about a woman's worth and purpose and promotes genuine violence. This is indeed a violation of women's civil rights and justifies the Minneapolis City Council in attempting to ban pornography.

This letter to the editor is, in effect, two syllogisms. The conclusion of the first is that pornography violates women's rights. This conclusion also functions as a premise in the second syllogism, which has as its own conclusion the claim that the Minneapolis City Council is justified in attempting to ban pornography. Both syllogisms have unstated premises. Translate the entire argument into standard-form syllogisms, supplying missing premises, and determine whether the reasoning is valid.

Exercise 8-25

Each of the following arguments contains an unstated premise, which, together with the stated premise, makes the argument in question valid. Your job is to identify this unstated premise, abbreviate each category with a letter, and put the argument in standard form.

- ▲ 1. Ladybugs eat aphids; therefore, they are good to have in your garden.
2. CEOs have lots of responsibility; therefore, they should be paid a lot.
3. Anyone who understands how a computer program works knows how important logic is. Therefore, anyone who understands how a computer program works understands how important unambiguous writing is.
- ▲ 4. Self-tapping screws are a boon to the construction industry. They make it possible to screw things together without drilling pilot holes.
5. No baseball player smokes anymore. Baseball players all know that smoking hampers athletic performance.
6. You really ought to give up jogging. It is harmful to your health.
7. Camping isn't much fun. It requires sleeping on the hard ground and getting lots of bug bites.
8. Having too much coffee makes you sleep poorly. That's why you shouldn't do it.
9. Do you have writer's block? No problem. You can always hire a secretary.
10. "You think those marks were left by a—snake? That's totally crazy. Snakes don't leave footprints."

Exercise 8-26

Diagram the argument found in the passage in Exercise 8-24 using the methods described in Chapter 2.

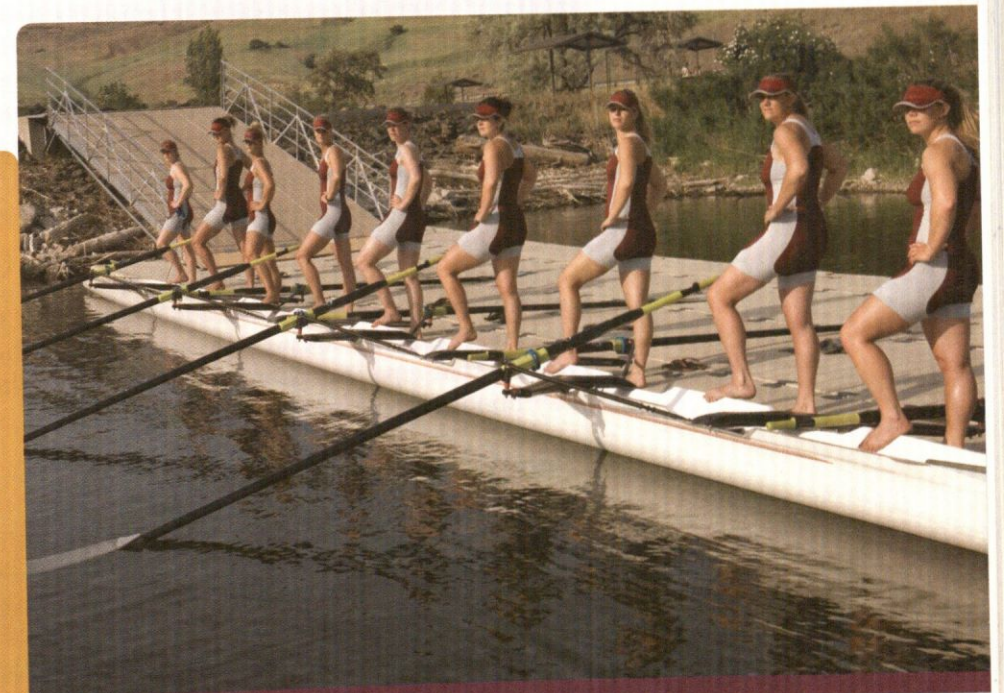
Writing Exercises

1. Should dogs be used in medical experiments, given that they seem to have the capacity to experience fear and feel pain? Write a short paper defending a negative answer to this question, taking about five minutes to do so. When you have finished, exchange arguments with a friend and rewrite each other's argument as a categorical syllogism or a combination of categorical syllogisms. Remember that people often leave premises unstated.
2. Follow the instructions for Writing Exercise 1, but this time defend the position that it is not wrong to use dogs in medical experiments.
3. Turn to Selection 15A, 15B, 16A, or 16B in the Appendix and follow the second alternative assignment.

9

Deductive Arguments II

Truth-Functional Logic



The earliest development of truth-functional logic took place among the Stoics, who flourished from about the third century B.C.E. until the second century C.E. But it was in the late nineteenth and twentieth centuries that the real power of **truth-functional logic** (known also as *propositional* or *sentential logic*) became apparent.

The “logic of sentences” is one of the bases on which modern symbolic logic rests, and as such it is important in such intellectual areas as set theory and the foundations of mathematics. It is also the model for electrical circuits of the sort that are the basis of digital computing. But truth-functional logic is also a useful tool in the analysis of language, and, in particular, of arguments.

The study of truth-functional logic can benefit you in several ways. For one thing, you'll learn something about the structure of language that you wouldn't learn any other way. For another, you'll get a sense of what it's like to work with a very precise, nonmathematical system of symbols that is nevertheless very accessible to nearly any student willing to invest a modest effort. The model of precision and clarity that such systems provide can serve you well when you communicate with others in ordinary language.

Students will learn to . . .

1. Understand the basics of truth tables and truth-functional symbols
2. Symbolize normal English sentences with claim letters and truth-functional symbols
3. Build truth tables for symbolizations with several letters
4. Evaluate truth-functional arguments using common argument forms
5. Use the truth-table and short truth-table methods to determine whether an argument is truth-functionally valid
6. Use elementary valid argument forms and equivalences to determine the validity of arguments
7. Use deductions to demonstrate the validity of truth-functional arguments